CONCRETE CONSTRUCTION CHAPTER 8

TYPES

Concrete construction usually requires forming; reinforcing mixing, placing, and finishing concrete; stripping forms; and curing concrete. In addition, some concrete construction requires fine grading, vapor barriers, expansion joints, cold- weather protection, and placement of embedded anchors in the concrete.

LABOR FOR FORMING

Labor required for forming includes fabrication, handling into place, erection, and oiling; installing form ties, tie wire, struts, chamfer strips, screed guides, bracing, and shoring, erecting runways and scaffolds; and checking forms during placement of concrete. Stripping includes removing, cleaning, and reconditioning forms. Forming is usually computed in square feet of contact surface, which is the area of concrete in direct contact with forms or in linear feet of form length required. Screed guides should be computed as the equivalent form length of an edge form.

LABOR FOR REINFORCED CONCRETE

Concrete is reinforced with steel bars or with welded steel wire mesh which is used for reinforcing slabs, gunite, and precast concrete. In some applications, wire mesh and bars are used in combination for reinforcing. Some tables show both bars and mesh, so that the appropriate man-hours per unit may be used. Reinforcing steel is computed in tons of bars. Reinforcing mesh is computed in square feet of the area.

Labor for reinforcing steel includes handling into place, tying, supporting, and any cutting which becomes necessary at the site such as cutting around embedded materials or cutting stock lengths of straight bars to fit slab dimensions. Labor for wire mesh reinforcing includes handling into place, cut - ting to fit, tying at overlaps, and pulling up into position during placement of concrete.

LABOR FOR MIXING CONCRETE

Sometimes concrete must be mixed at the job site rather than being delivered in transit mix trucks. Labor for mixing concrete at the jobsite includes loading, measuring, wheeling, and dumping aggregates and cement into the mixer; bringing water to the mixer by truck, hose, pipe, or pump; and operating the mixer.

LABOR FOR PLACING CONCRETE

Handling from the mixer or transit mixer truck to the final position is included in placing concrete. This includes hoisting, spreading, vibrating, and screeding the concrete to grade.

LABOR FOR FINISHING CONCRETE

Concrete finishing includes floating, troweling, and tooling slabs: and filling voids and honeycombs. Pointing and patching includes patching tie holes and removing fins.

LABOR FOR CURING CONCRETE

The term curing includes covering surfaces with curing compound, sand, paper, tarpaulins, burlap, or straw, and keeping as wet as required.

FINE-GRADING PROCESS

The process of fine grading includes bringing in fill or removing excess earth, spreading, leveling, compacting, and sprinkling when necessary.

VAPOR-BARRIER PLACEMENT

The process of placing vapor barrier includes handling and placement, cutting to fit, smoothing as necessary, and sealing the joints.

EXPANSION JOINTS

Placing premolded expansion joints includes handling into place, cutting to fit, placing, and fastening to hold in position until concrete is placed. Labor for placing poured expansion joints includes cleaning the joints of foreign matter, handling material to the melting pot, melting, handling to the joints, pouring the joints, and dusting.

COLD-WEATHER PROTECTION

Several methods are available to provide cold-weather protection for concrete. These include covering the concrete with sand, straw, or paper; heating the mixing water and aggregate; and building enclosures and operating heaters.

ESTIMATING TABLES

Work rates in Tables 8-1 through 8-8, pages 8-3 through 8-6, are based on the use of untrained troops. If crews of different makeup are employed, the work rates must be adjusted accordingly. The tables do not include loading and hauling materials to the jobsite. Table 8-9, page 8-7, contains conversion and waste factors.

Table 8-1. Concrete mixing and placing

Work element description	Unit	Man-hours/unit
Hand mix:		
1 Mix board[1]	cu yd	2.50
16S Mixer:		
Charging with wheelbarrows		
Large crew[2]	cu yd	1.70
Small crew[3]	cu yd	2.00
M919 Concrete Mobile (mixing only)	cu yd	0.10
Placing:[4]		
Placing directly into forms	cu yd	0.40
Using wheelbarrows	cu yd	1.50
Using concrete buggies	cu yd	1.25

[1]Crew: 9 to 10 workers.
[2]Crew (14 workers): 1 operator, 7 with wheelbarrows loading gravel, 4 with wheelbarrows loading sand, and 2 on cement.
[3]Crew (8 workers): 1 operator, 4 with wheelbarrows loading gravel, 2 with wheelbarrows loading sand, and 1 on cement.
[4]Crew (9 workers): 1 leader, 6 wheeling concrete, and 2 dumping and screeding.

Table 8-2. Concrete footings and foundations

Work element description	Unit	Man-hours/unit
Formwork:*		
Column footings (assume 5' x 5' x 1 1/2')	100 sq ft of contact surface	8.5
Wall footings (assume 1 foot deep)	100 sq ft of contact surface	5.5
Footing keys (assume 2" x 4")	100 lin ft	3.2
Reinforcing:		
Loose in footings and piers	ton	13.0
Wired in place (vertical and horizontal)	ton	18.0
Mesh or fabric reinforced	100 sq ft	0.5

*Crew: 2 carpenters and 1 helper.

Table 8-3. Concrete slabs on grade

Work element description	Unit	Man-hours/unit
Fine grade[1]	100 sq ft	1.20
Formwork - edge form[2]	100 lin ft	4.50
Screeds[3]	100 lin ft	1.25
Strip forms ≤ 12-inch[1]	100 lin ft	1.75
Reinforcing[1]		
Bend bars ≤ Number 8	1 ton	10.00
Bend bars > Number 8	1 ton	5.00
Place bars < Number 6	1 ton	15.00
Place bars ≥ Number 6	1 ton	12.00
Wire mesh	100 sq ft	2.00
Finish[1]		
Trowel (includes float)	100 sq ft	2.50
Float	100 sq ft	2.00

[1]Crew: 1 worker.
[2]Crew: 2 carpenters and 1 helper.
[3]Crew: 2 workers.

Table 8-4. Concrete structural slabs

Work element description	Unit	Man-hours/unit
Formwork:		
Flat slab including shoring[1]	100 sq ft of contact surface	12.0
Beam bottom, beam sides[1]	100 sq ft of contact surface	17.5
Edge form ≤ 12 inches[1]	100 lin ft	7.0
Strip forms[2]	100 sq ft	2.0
Reinforcing[2]		
Same as Table 8-3 but hoisting of materials to slab level must be added.		
Finish:		
Same as Table 8-3		
Carborundum stone rub underside	100 sq ft	1.2
Placing:		
Rate of placing will depend on the method of hoisting the concrete.		

[1]Crew: 2 carpenters and 2 helper.
[2]Crew: 1 worker.

Table 8-5. Concrete walls

Work element description		Unit	Man-hours/unit
Formwork:[1]	Wall height (feet)		
Panel wall forms			
Making only	4 - 8	100 sq ft	5.8
Erect and remove	3 - 4	100 sq ft	5.0
Erect and remove	5 - 8	100 sq ft	9.0
Foundation wall forms	4 - 8	100 sq ft	10.5
Foundation wall forms	9 - 12	100 sq ft	14.0
Foundation wall forms	13 - 20	100 sq ft	19.0
Built-in-place forms	4 - 8	100 sq ft	14.5
Built-in-place forms	9 - 12	100 sq ft	19.0
Built-in-place forms	13 - 20	100 sq ft	24.0
Reinforcing:			
Set bars		ton	24.7
Set bars and tie in place		ton	27.5
Cure and cleanup		1,000 sq ft	1.0
Finish (Carborundum stone)		100 sq ft	2.8
Patch tie holes[2]		100 sq ft	1.2

[1]Crew: 2 carpenters and 1 helper.
[2]Crew: 1 finisher and 1 laborer.

Table 8-6. Concrete columns and beams

Work element description	Unit	Man-hours/unit
Formwork:[1]		
Column forms (for example, plywood sheathing)	100 sq ft of contact surface	20.5
Inside beam and girder forms with shoring	100 sq ft of contact surface	21.5
Spandrel beam or lintel forms with shoring	100 sq ft of contact surface	26.7
Reinforcing:		
Set bars	ton	26.5
Set bars and tie in place	ton	29.5
Finish (Carborundum stone)	100 sq ft	2.8
Cure and cleanup	100 sq ft	0.1
Patch tie holes[2]	100 sq ft	1.2

[1]Crew: 2 carpenters and 1 helper.
[2]Crew: 1 finisher and 1 laborer.

Table 8-7. Cast-in-place concrete culverts

Work element description	Unit	Man-hours/unit
Formwork:[1]		
Plywood sheathing and such	100 sq ft of contact surface	26.7
Place reinforcing:		
Set bars and tie in place	ton	31.5
Mix and place concrete[2] (16S mixer)	cu yd	2.7
Place ready-mix concrete[3]	cu yd	2.2
Finish	1,000 sq ft	36.0
Cure and cleanup	1,000 sq ft	1.0
Finish (Carborundum stone)	1,000 sq ft	32.0

[1]Crew: 2 carpenters and 1 helper.
[2]See Table 8-1, page 8-3, for crew.
[3]Typical crew: 1 crew leader; 4 workers erecting strip forms; 3 workers placing reinforcements; 6 to 8 workers placing, spreading, and vibrating concrete; 1 to 3 workers finishing; and 1 to 2 workers cleaning up.

Table 8-8. Cast-in-place concrete and installation of precast catch basins

Work element description	Unit	Man-hours/unit
Cast-in-place units:		
Formwork:[1]		
Plywood sheathing, etc.	100 sq ft of contact surface	26.7
Reinforce:		
Set bars and tie in place	ton	31.5
Place manhole frame and cover	ea	3.0
Place catch basin grate	ea	2.0
Mix and place concrete[2] (16S mixer)	cu yd	3.2
Place ready-mix concrete	cu yd	2.7
Finish	100 sq ft	3.6
Cure and cleanup	ea	1.0
Overall:		
For all sizes of all units	cu yd	15.0
Precast units: See Table 6-5, page 6-5, for amount of labor per various sized units.		

[1]Crew: 2 carpenters and 1 helper.
[2]Mix crew: 5 workers on materials feeding mixer and 1 worker dumping concrete into buggies.
[3]Placing crew: 1 crew leader, 3 to 5 workers setting and removing forms, 4 to 7 workers reinforcing, and 3 to 5 workers placing concrete.

Table 8-9. Conversion and waste factors

Material	Conversion	Percent waste
CONCRETE CONSTRUCTION		
Concrete (1:2:4)		
Cement	6.0 sacks/cu yd	10
Fine aggregate	0.5 cu yd/cu yd	10
Coarse aggregate	0.9 cu yd/cu yd	10
Curing compound	0.5 gallon/100 sq ft	10
Forms		
Footings and piers		
2 x 4	1.5 lin ft/sq ft of contact surface	20
2 x 8	0.2 lin ft/sq ft of contact surface	10
2 x 12	0.7 lin ft/sq ft of contact surface	5
Walls and columns		
2 x 4	1.3 lin ft/sq ft of contact surface	20
Plywood (50% reuse)	0.5 sq ft/sq ft of contact surface	5
Beams and suspended slabs		
1 x 6	0.3 lin ft/sq ft of contact surface	5
2 x 4	0.5 lin ft/sq ft of contact surface	20
2 x 10	0.1 lin ft/sq ft of contact surface	10
4 x 4	0.4 lin ft/sq ft of contact surface	5
4 x 6	0.1 lin ft/sq ft of contact surface	5
Plywood	0.5 sq ft/sq ft of contact surface	5
Form oil	0.5 gal/100 sq ft	10
Tie wire	12.0 lb/ton	10
Snap-tie wedges	0.1 ea/sq ft of contact surface	5
Snap ties	0.1 ea/sq ft of contact surface	5
She bolts	0.1 set/sq ft of contact surface	5
Nails (bd ft lumber, sq ft plywood, ordered as thousand bd ft measure)		
6d box	6 lb/thousand bd ft measure	10
8d common	4 lb/thousand bd ft measure	10
16d common	6 lb/thousand bd ft measure	10
20d common	2 lb/thousand bd ft measure	10
6d duplex	4 lb/thousand bd ft measure	10
8d duplex	9 lb/thousand bd ft measure	10
16d duplex	9 lb/thousand bd ft measure	10